

WHAT IS CLAIMED IS:

1. An apparatus comprising:  
an accelerator waveguide comprising an end cavity, the accelerator  
5 waveguide to output first particles from the end cavity at a first energy in a  
first mode and to output second particles from the end cavity at a second  
energy in a second mode; and  
a detuning device coupled to the end cavity.
- 10 2. An apparatus according to Claim 1, the detuning device comprising:  
a probe movable between a first position in the first mode and a  
second position within the end cavity in the second mode.
- 15 3. An apparatus according to Claim 1, the detuning device comprising:  
an electrical circuit including an electrical conductor, a portion of the  
electrical conductor disposed within the end cavity.
- 20 4. An apparatus according to Claim 3, wherein a characteristic of the  
electrical circuit is controllable to selectively detune the end cavity.
- 25 5. An apparatus according to Claim 3, the electrical circuit comprising:  
a first coaxial cable coupled to the electrical conductor;  
a second coaxial cable; and  
a switch to selectively couple the first coaxial cable to the second  
coaxial cable.
- 30 6. An apparatus according to Claim 1, further comprising:  
an RF power source to transmit a first wave having a first power to the  
accelerator waveguide in the first mode, and to transmit a second wave  
having a second power to the accelerator waveguide in the second mode.
7. An apparatus according to Claim 1, further comprising:

a particle source to inject particles at a first current into the accelerator waveguide in the first mode, and to inject particles at a second current into the accelerator waveguide in the second mode.

5           8. An apparatus according to Claim 1, further comprising:  
a control unit to receive an instruction to switch from the first mode to the second mode, and to control the detuning device to detune the end cavity in response to the instruction.

10           9. A method comprising:  
operating an accelerator waveguide to output first particles from a tuned end cavity of the accelerator waveguide at a first energy;  
detuning the end cavity; and  
operating the accelerator waveguide to output second particles from  
15 the detuned end cavity at a second energy.

20           10. A method according to Claim 9, wherein detuning the end cavity comprises:  
changing a resonant frequency of the end cavity.

25           11. A method according to Claim 9, wherein detuning the end cavity comprises:  
moving a probe to a position within the end cavity.

30           12. A method according to Claim 9, wherein detuning the end cavity comprises:  
changing an electrical characteristic of a circuit coupled to the end cavity.

35           13. A method according to Claim 12, wherein the electrical characteristic is an impedance of the circuit.

14. A method according to Claim 12, wherein changing the electrical characteristic of the circuit comprises:  
coupling a coaxial cable to the end cavity.

5           15. A method according to Claim 9, wherein operating the accelerator waveguide to output first particles from the tuned end cavity at the first energy comprises:

operating an RF power source to deliver a wave having a first power to the accelerator waveguide, and

10           wherein operating the accelerator waveguide to output second particles from the detuned end cavity at the second energy comprises:

operating the RF power source to deliver a wave having a second power to the accelerator waveguide.

15           16. A method according to Claim 9, wherein operating the accelerator waveguide to output first particles from the tuned end cavity at the first energy comprises:

operating a particle source to inject particles at a first current into the accelerator waveguide, and

20           wherein operating the accelerator waveguide to output second particles from the detuned end cavity at the second energy comprises:

operating the particle source to inject particles at a second current into the accelerator waveguide.

25           17. A method according to Claim 9, further comprising:

receiving an instruction to switch between operation of the accelerator waveguide at the first energy and operation of the accelerator waveguide at the second energy; and

automatically detuning the end cavity in response to the instruction.

30           18. A medium storing processor-executable process steps, the steps comprising:

a step to operate an accelerator waveguide to output first particles from a tuned end cavity of the accelerator waveguide at a first energy;  
a step to detune the end cavity; and  
a step to operate the accelerator waveguide to output second particles  
5 from the detuned end cavity at a second energy.

19. A medium according to Claim 18, wherein detuning the end cavity comprises:  
a step to change a resonant frequency of the end cavity.  
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20. A medium according to Claim 18, wherein detuning the end cavity comprises:  
a step to move a probe to a position within the end cavity.

15 21. A medium according to Claim 18, wherein detuning the end cavity comprises:  
a step to change an electrical characteristic of a circuit coupled to the end cavity.

20 22. A medium according to Claim 21, wherein the electrical characteristic is an impedance of the circuit.

23. A medium according to Claim 21, wherein the step to change the electrical characteristic of the circuit comprises:  
25 a step to couple a second coaxial cable to the end cavity.

24. A medium according to Claim 18, wherein the step to operate the accelerator waveguide to output first particles from the tuned end cavity at the first energy comprises:  
30 a step to operate an RF power source to deliver a wave having a first power to the accelerator waveguide, and

wherein the step to operate the accelerator waveguide to output second particles from the detuned end cavity at the second energy comprises:

- 5 a step to operate the RF power source to deliver a wave having a second power to the accelerator waveguide.

25. A medium according to Claim 18, wherein the step to operate the accelerator waveguide to output first particles from the tuned end cavity at the first energy comprises:

- 10 a step to operate a particle source to inject particles at a first current into the accelerator waveguide, and

wherein the step to operate the accelerator waveguide to output second particles from the detuned end cavity at the second energy comprises:

- 15 a step to operate the particle source to inject particles at a second current into the accelerator waveguide.

26. A medium according to Claim 18, further comprising:

- 20 a step to receive an instruction to switch between operation of the accelerator waveguide at the first energy and operation of the accelerator waveguide at the second energy; and

a step to automatically detune the end cavity in response to the instruction.